# Sartorius
# Moisture Analyzer MA 30
# Service Manual.

**WYM5006-e90051**

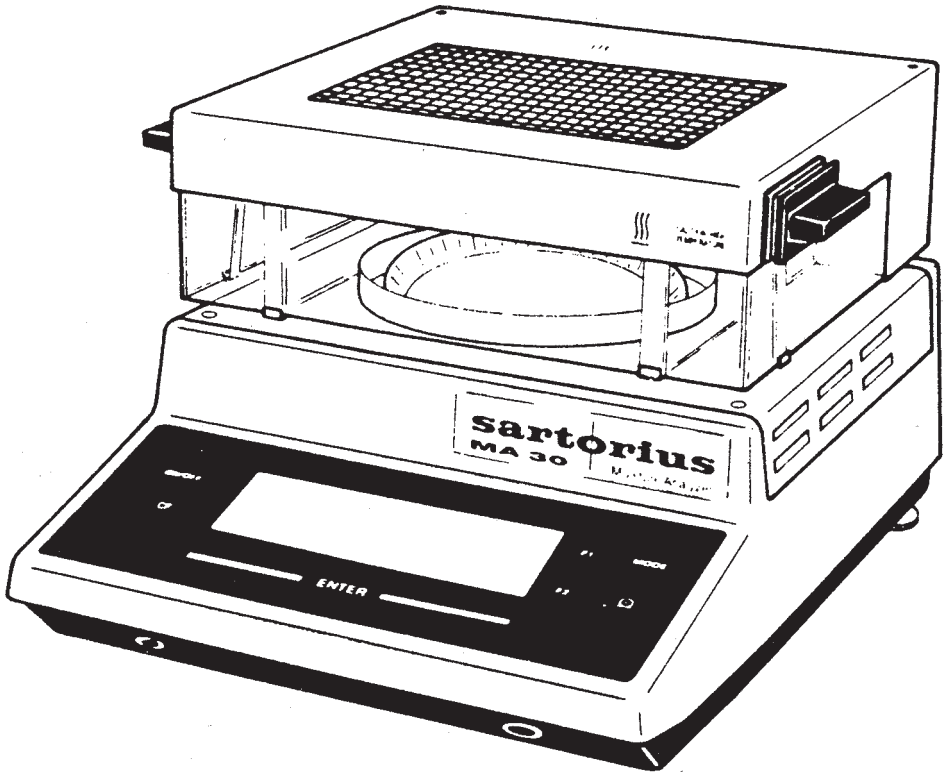


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**Table of Contents** **Page**

**Exploded-view Diagram 1 ..... 3**
**Exploded-view Diagram 2 ..... 4**
**Exploded-view Diagram 3 ..... 5**
**Exploded-view Diagram 4 ..... 6**

**1. MA30 Moisture Analyzer ..... 7**

1.1 Safety Precautions/Safety Inspection ..... 7
1.2 Additional Service Tools and Equipment ..... 8
1.3 Accompanying Literature ..... 9
1.4 Special Features of the MA 30 Moisture Analyzer ..... 9
1.5 How to Operate the MA 30 - Brief Instructions ..... 10
1.6 Error Messages ..... 11

**2. Description of the Functions ..... 13**

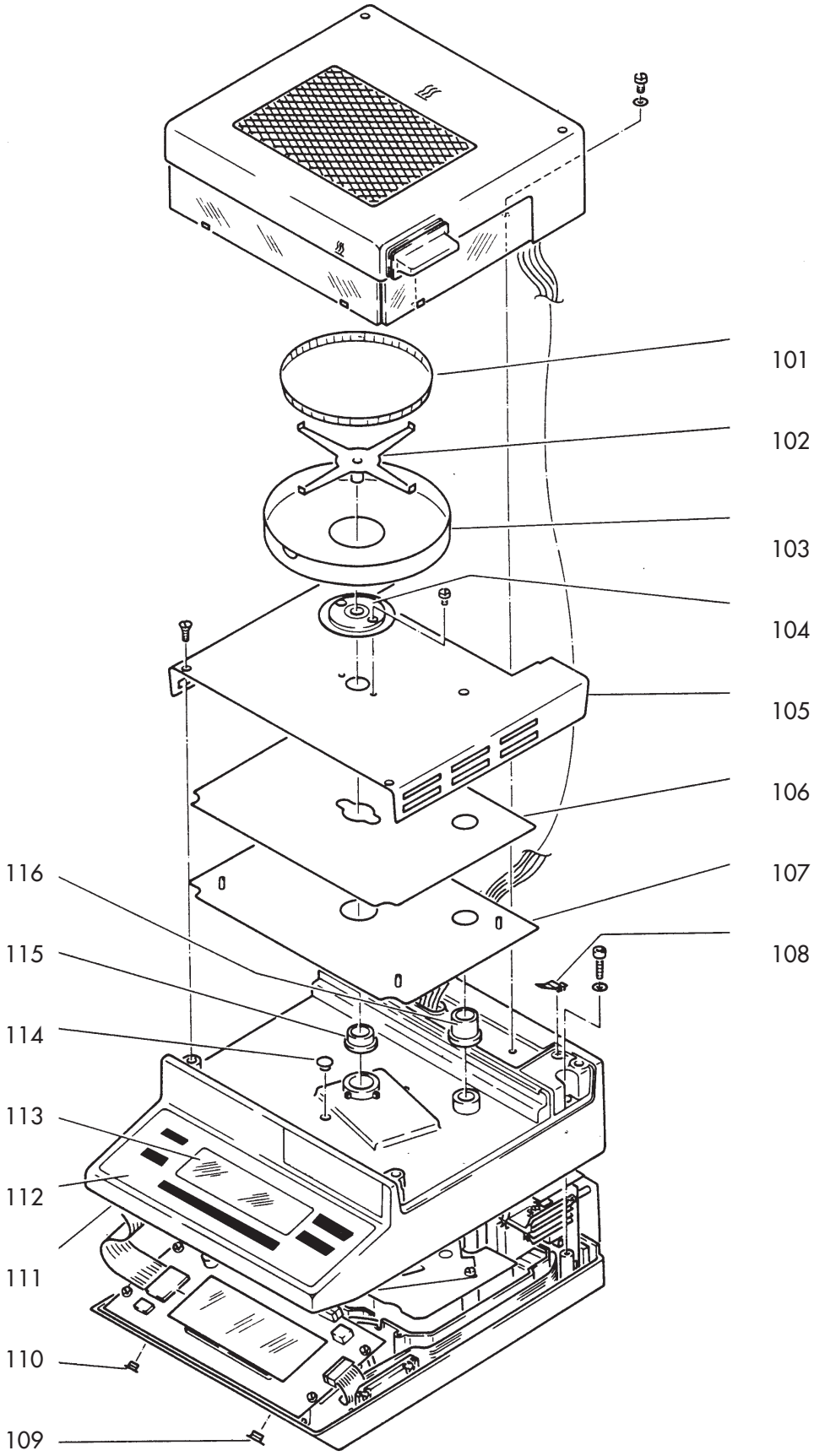
2.1 Functions of the MA30 ..... 13
2.2 Block Diagram of the MA30 ..... 14
2.3 Semiconductor Functions ..... 15

**3. Testing/Adjusting ..... 17**

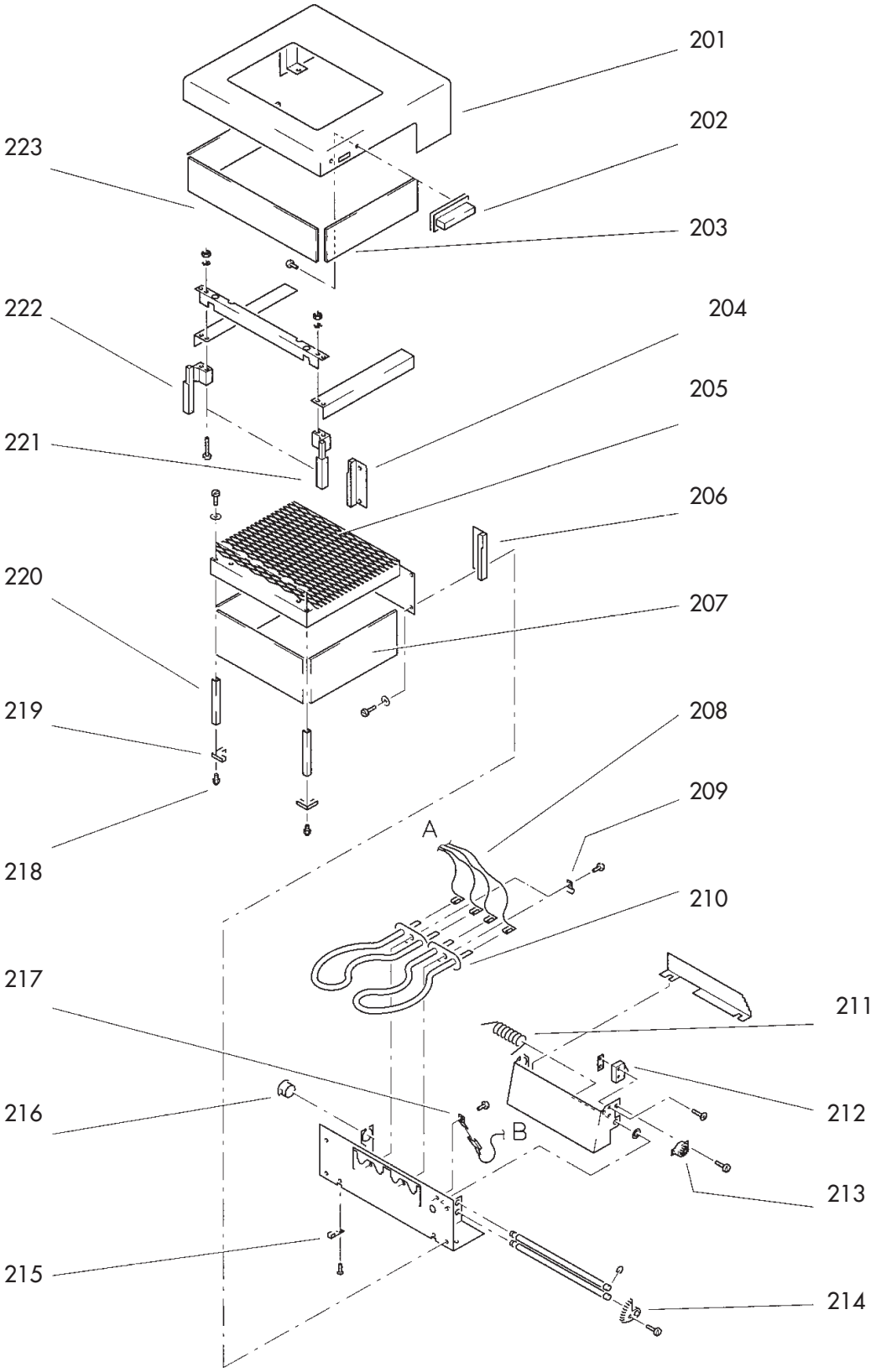
3.1 Specifications/Adjustment Data ..... 17
3.2 Calibration ..... 18
3.3 Adjusting the Temperature ..... 19
3.4 Opening the MA 30 Housing ..... 20
3.5 Testing the Weighing Subassembly ..... 21
3.6 Testing the Drying Subassembly ..... 22
3.7 Test Points ..... 22

Circuit Diagram for the MA30 ..... 25

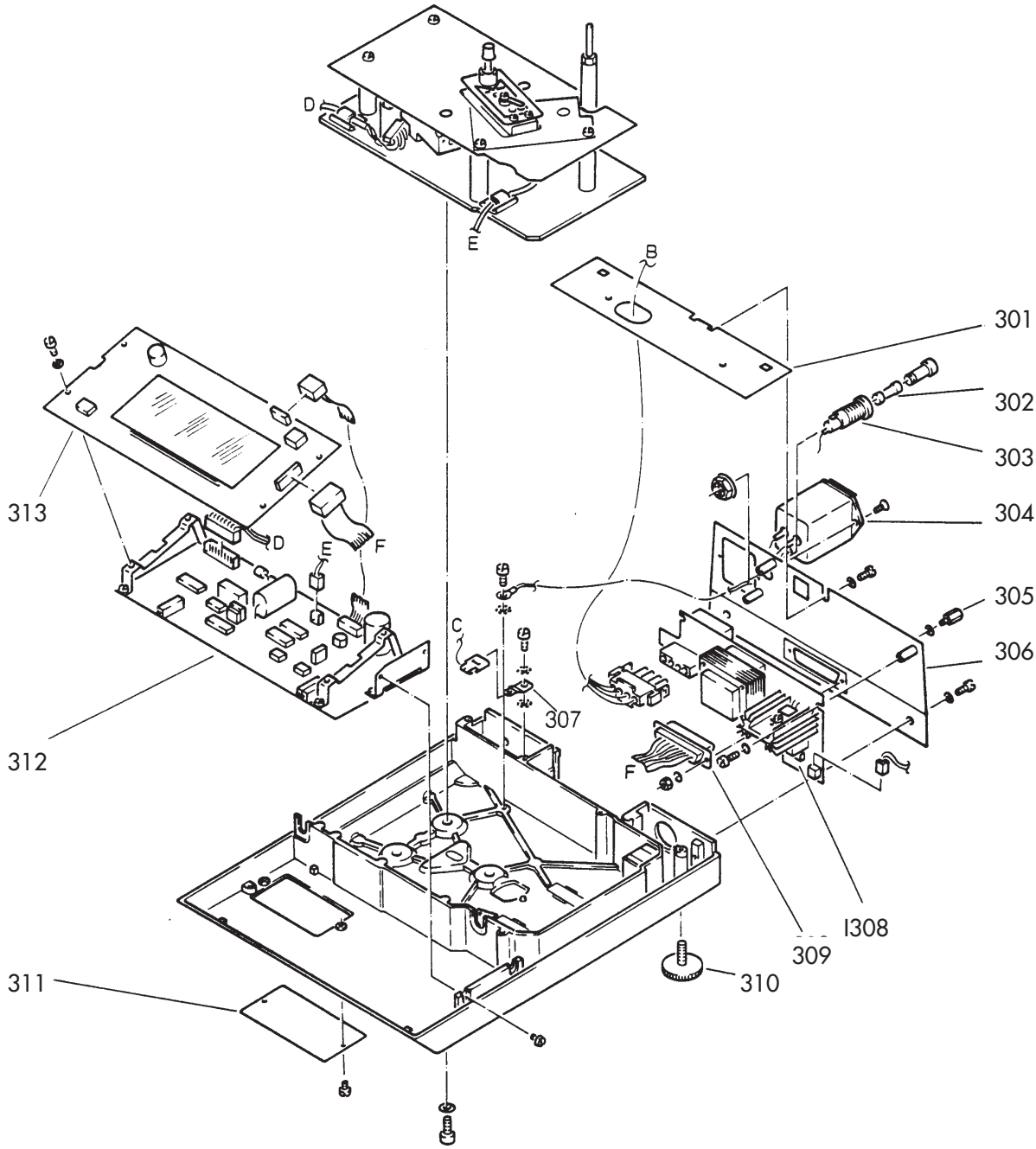
## Exploded-view Diagram 1



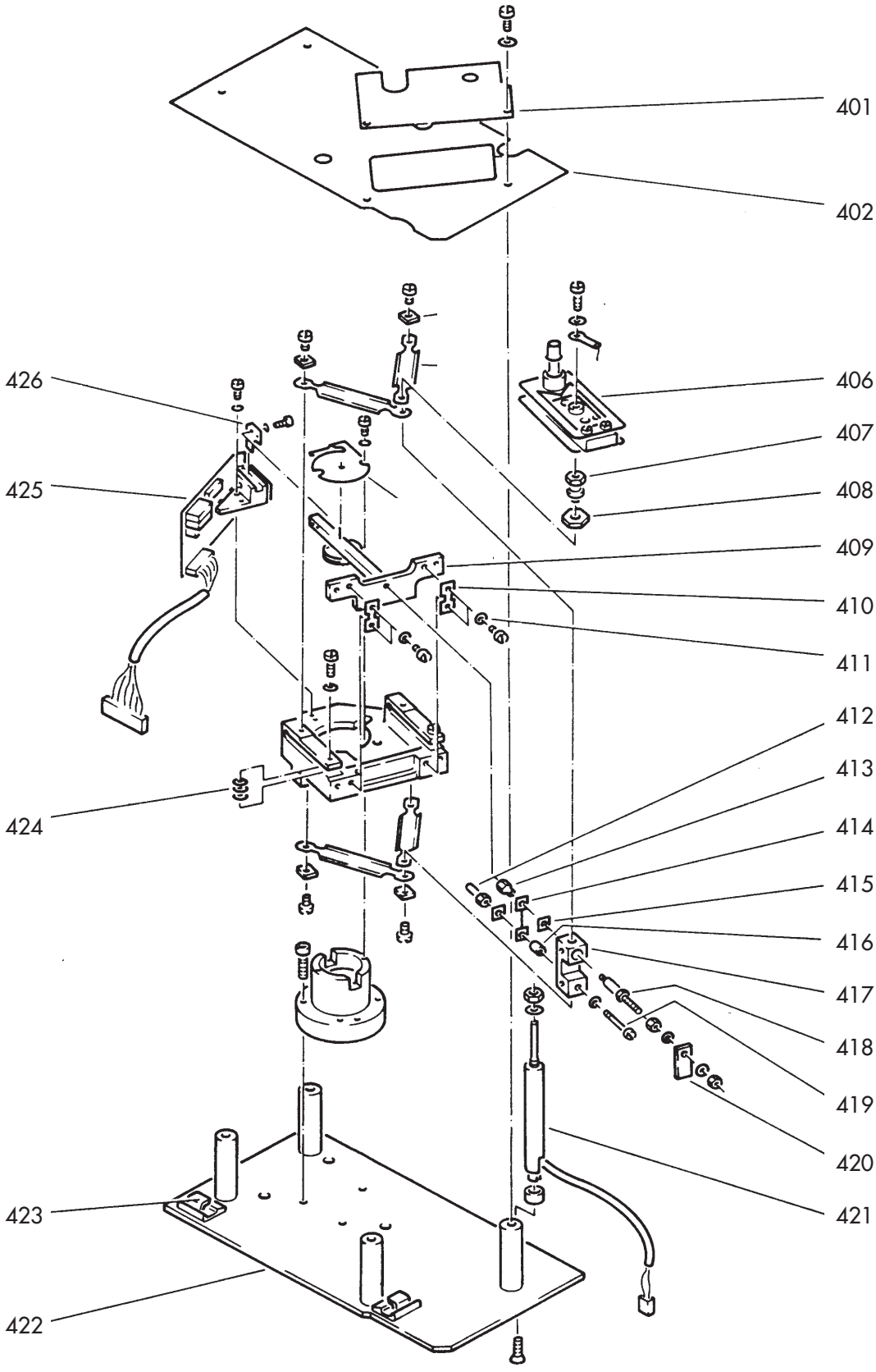
## Exploded-view Diagram 2



## Exploded-view Diagram 3



## Exploded-view Diagram 4



# 1. MA 30 Moisture Analyzer

## 1.1 Safety Precautions/Safety Inspection

It is life threatening to operate the MA 30 Moisture Analyzer while the housing is open because line voltage-conducting components are exposed.

Please observe the following when you open the MA 30 housing:

- Operate the MA 30 Moisture Analyzer only with a **protective isolation transformer**.
- Use the specially marked main **emergency off switch**.
- All **soldering equipment** must be double insulated (have its own protective isolation transformer). Do not use grounded soldering tips.
- Measuring instruments, such as an oscilloscope, must comply with local safety regulations in order to be connected to equipment which conducts line voltage (mains).
- Your **work area** must comply with laboratory safety regulations.
- The MA 30 Moisture Analyzer may only be opened by **authorized Sartorius service technicians**.

- Before you begin with repairwork, **determine** which components are voltage-conducting. **Incorrect usage** of service tools and measuring instruments can **damage the semiconductors beyond repair**. If such damage occurs, it is very difficult to repair the MA 30.
- It is, therefore,often faster and more economical to **excatnge both printed circuit boards (PCB's)**.
  If you need to exchange a PCB, just send the defective, **but repairable**, PCB to Sartorius. We'll be happy to send you a replacement at a price you can afford.
- If you would like to repair the PCB´s yourself, you will need SMD soldering equipment with matching solder applicators.

## 1.2 Additional Service Tools and Equipment

In addition to the appropriate tools, it is necessary to set up and operate your MA 30 Moisture Analyzer in a stable, clean work area that is free of vibrations and drafts.

For more Information, please refer to the following technical literature:

- Service Tools for Service and Repairwork of Mechanical and Electronic Balances/Scales 9/85
- Supplementary List 1/88
- Electronic Components

| | Order no. |
|---|---|
| Service equipment for the weighing cell (Please refer to the Service Manual for Handy/Gem Series Balances under “H51.”) | |
| Disk for temperature measurement YTCO1L/MA30/MA50 | 6739-67 |
| Thermocouple module | 6739-51 |
| Digital multimeter (Beckmann 3030), suitable for RMS | 6738-62 |
| or, if available: | |
| Electronic temperature measuring device 7393-10 (Please note: This device has been discontinued) | |
| Soldering station | 6737-95 |
| Hot air soldering station for SMD components | |
| oscilloscope (20 MHz) | |
| Constant voltage source, e.g. Analogic AN 3100 | |
| Regulating protective isolation transformer | |
| Use weights rated to Class E2: | |
| Complete set of test weights | 6714-00 |
| Metal film resistor assortment E12 | 6970400 |

For guidance on which parts you should keep in stock, please see he **spare parts kit** suggested on the last pages of the spare parts list.

## 1.3 Accompanying Literature

The MA 30 Moisture Analyzer is a complete unit consisting of both a weighing and a drying subassembly.

Consult the following supplemental literature in addition to this service manual:

- Installation and Operating instructions for the Moisture Analyzer, Model MA 30
- Applications Handbook for the Sartorius Thermo Control Infrared Dryer
- Spare Parts List for the Moisture Analyzer, Model MA 30
- Service Manual for the Moisture Analyzer, Model MA 50
- Service Manual for Handy/Gem Series Balances

## 1.4 Special Features of the MA 30 Moisture Analyzer

- A drying program, which can be changed to accomodate the customer's specific applications. You can store short-term settings in the RAM area of the processor. Long-term settings can be stored in the EEPROM (even in the absence of power). (See the Installation and Operating Instructions for the MA 30 under "How to Change Parameters.")
- Two different unit functions, which can be implemented in the programs if the customer desires.

  Temperature control function with

  automatic start or
  manual start according to the time entered.

  Please see the section entitled "More Information on the Moisture Analyzer" beginning on page 18 in the Applications Handbook.

  Also see the section entitled "Performance Features" in the Installation and Operating Instructions.

- Peripherals can be connected to the standard MA 30 interface. However, data can only be read fromthis port.

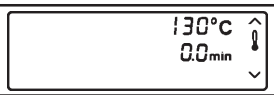
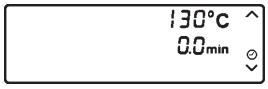
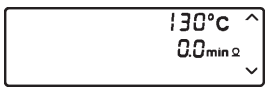
## 1.5 How to Operate the MA30 - Brief Instructions

### How to Run a Routine

| | |
|---|---|
| Turn on unit | ON/OFF |
| Select display mode | MODE |
| Lift hood and position disposable dish | |
| Zero the display | ENTER |
| Add sample to dish: lower hood | |
| Routine starts automatically or when you press | ENTER |
| When "END" is displayed, read off result | |
| To start a new routine,press | CF |

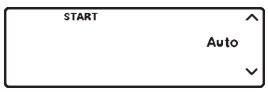
### How to Change the Parameters

After you press:

| | | | | |
|---|---|---|---|---|
| CF | when display shows | | | |
| TEMP | temperature |  | TEMP higher<br>TIME lower | + ENTER |
| TIME | shut off time<br>0.0min.:auto. |  | TEMP increase<br>TIME decrease | + ENTER |
| Print | print interval |  | TEMP longer<br>TIME shorter | + ENTER |

### Weighing-in and start functions

when you turn on the unit keeping one of the keys below pressed:

| | | | | |
|---|---|---|---|---|
| MODE | start |  | TEMP<br>TIME with ENTER<br>Auto(matic) | + ENTER |
| ENTER | convenience feature<br>for weighing-in 0g=off | | TEMP increase<br>TIME decrease | + ENTER |

### How to Store the Parameters

| | |
|---|---|
| No changes; parameters remain stored | CF |
| Store changes only temporarily<br>(until unit is unplugged) | ENTER |
| Store changes permanently<br>(until next overwriting procedure) | hold down ENTER<br>until unit shuts off |

## 1.6 Error Messages

Error messages displayed by balances and scales with MP8.7-3 technology (such as CH...., E..) are not implemented in the MA 30.

Refer to the following list for troubleshooting:

**The display does not light up;** the MA 30 does not perform a full-segment display test after you turn it on, and the standby symbol "⏻" is not displayed:

No operating voltage, defect in the power supply, the required 5 V are not generated, defect in the IC102 processor

**The standby symbol "⏻" is displayed, but the unit does not start:**

The current from the ON/OFF key is interrupted; reset component TL7705 is defective.

**The unit starts, but the indication returns to the standby symbol "⏻" after the full-segment display test:**

The processor cannot read in the parameters for the weighing and drying subassemblies after the full-segment display test. This indicates a defect in the parameter EEPROM.

**L or H is displayed:**

The weighing system cannot stabilize (mechanical defect), preload, calibration, 5 V, -12 V, control amplifier, A/D converter of the weighing system.

**L or H (when the weighing system is loaded) is displayed, but no intermediate values appear:**

A/D converter of the weighing system: AD3 IC203, reference element IC204, processor IC102.

**Values are displayed without the "g" symbol, and C (Indicating calibration) appears in the LCD:**

Non-existent or erroneous data in EEPROM IC101; dryer enters the calibration mode automatically.

**The display does not function properly:**

AZ101 LCD, processor.

The A/D converter for temperature consists of the following semiconductors:
D203, IC209, IC208, IC210, IC211, T203, Z201, temperature sensor.
The dryer starts; however, the following malfunction/error occurs:

- **The heating elements do not function.**

Power control PCB defective, triac TC301, optocoupler OK301, processor IC102.

Break (interruption) in the temperature measuring sensor. You can measure this using the integrator output for temperature measurement (IC209/PIN 7).
Normal: temperature-dependent ramp
Defective: H potential

- **Too much heat is emitted, or heat is only briefly generated; no temperature regulation.**

Short circuit in the temperature measuring sensor. Measure this at the integrator output for temperature measurement (IC209/PIN 7).
Normal: temperature-dependent ramp
Defective: L potential

When the unit functions properly, the ramp measured at IC209/PIN 7 is similar to that of the A/D converter of the balance. Only the frequency for charging and decharging the integrator capacitor is lower.

If you carefully apply heat to the temperature sensor, i.e., using a soldering iron, the ramp will change.

- **The temperature levels measured with the measuring disk are incorrect.**

Since the dryer is a relatively open unit, drafts can influence the temperature to a certain extent. The temperature may deviate up to +/- 5°C (measured with the disk for temperature measurement, 6739-67).

The A/D converter for temperature measurement is defective.
The zero-point offset or the sensitivity has been adjusted incorrectly.
Adjust the zero-point offset for the initial temperature using potentiometer P202.
Use potentiometer P203 to adjust the sensitivity for the final temperature.

Both potentiometers are accessible from the front right side of the dryer, even if it is closed. They are very close together behind the black plastic cap: P202 on the left, P203 on the right.
The settings on both potentiometers influence each other.

# 2. Description of the Functions

## 2.1 Functions of the MA 30

The weighing subassembly of the MA 30 is very similar to that of the H51 Analytical Balance or the MA 50 Moisture Analyzer.

The **zero position detector (null indicator)** consists of light emission diode LD401 (LD242II), receiving diode FD401 (BPX48), and the IC401 quadruple operational amplifier (LF444).

The IC402 (CA3132) operational amplifier dampens mechanical oscillations **(PID regulator)** of the weighing cell and controls the final amplifier, which consists of IC401 (LF444) and **final transistor** T402 (BC307). The output voltage flows through a **compensating coil** and **a precision resistor**. The analog measuring voltage at the precision resistor is proportional to the weight loaded on the weighing system. The precision resistor constitutes the “interface” between the components which generate the measured values (weighing cell, control amplifier) and those for processing the measured values (A/D converter, processor, LCD).

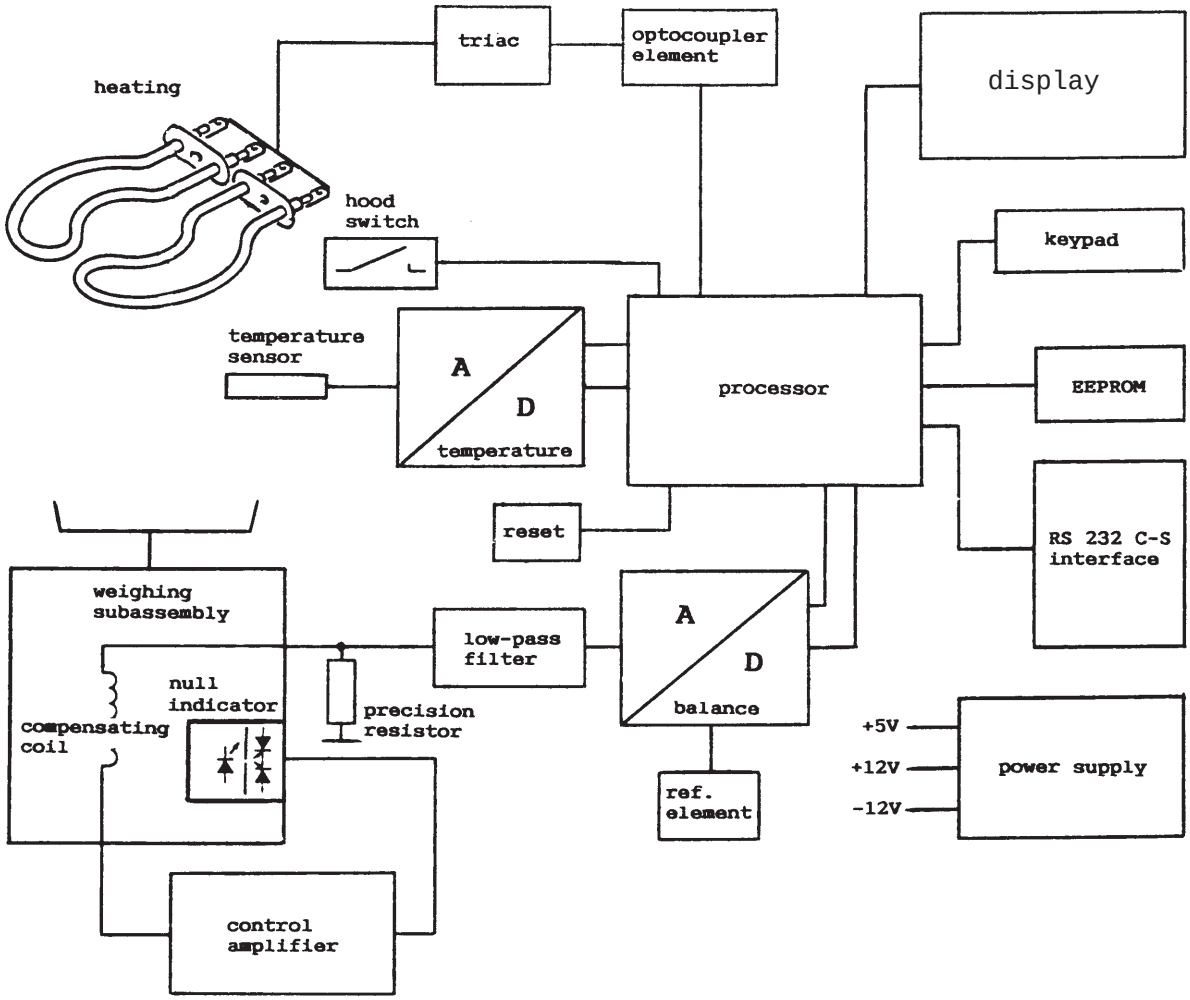
The analog signal measured is transmitted to the **A/D converter** (dual slope procedure) via **active low-pass filter** IC201, T201 (BC307B). The A/D converter consists of an integrator, a comparator, an electronic switch in IC203 (AD 3), reference element IC204 (LM329), a time base, and a latch in processor IC102 (MB88545). In addition to controlling the A/D converter, the **processor** also monitors the A/D converter for temperature measurement, compares the actual temperature to the preselected temperature for the program **(EEPROM HY93C46)**, and controls the **TC301 triac (BT138)** by transmitting a pulse-width modulated signal. The entire heating cycle lasts approx. 6 seconds. The duty cycle depends on the program and the temperature selected.

The **A/D converter (for temperature measurement)** is similar to the A/D converter of the weighing system and consists of **a reference element** Z201 (ZPD2, 7); **a constant current source** for the **temperature sensor** (ST202/1 and 2);
**integrator** IC209 (LM358); **comparator** IC208 (CA3130); divider IC211 (HCT4020); J/K flip flop IC210 (74HCT73) for linking the **time base** and the comparator pulse; and **electronic switch** T203 (VN1OKM).

The **settings for the drying program** can be stored in the processor (RAM) for short periods or in the EEPROM for long periods.

The **RS 232C data interface** (MAX232) is also controlled by the processor.

## 2.2 Block Diagram of the MA30



## 2.3 Semiconductor Functions

IC101 M93C46): EEPROM, an external non-volatile memory. Specific values for the weighing system and dryer are stored here. Data communication with the processor is serial via DI and DO.

IC102 (MB88545): An 80-leg processor which features SMD technology and the following functions:

- Quartz oscillator
- Direct contact to the membrane-tactile keypad
- Control of the A/D converter of the weighing system
- Timing pulse for the A/D converter for temperature measurement
- Interface for data communication with a permanent 7-bit ASCII setting
  - Synchronization, 1 start bit, 1 stop bit
  - 1,200 baud
  - ODD parity
- Calculation of weighing system and dryer data
- Display driver
- Generation of the pulse-width-modulated signal for heating

IC103 (MAX232): RS 232C interface

IC104 (TL7705): Reset for the processor

T101 (VN10KM): Control FET for the pulse-width-modulated signal
Input: Pulse-width-modulated rectangle from the processor; entire cycle lasts 6 seconds; pulse duty factor changes with modulation.
Output: Same as input, except inverted with level of approx. 1 V.

T102/T103 (BCW60/BM61): Recognition of the print command from peripherals (software) to the processor (hardware, IC102 PIN/23)

IC201 (LM308): Op. amp., low-pass filter

T201 (BC307): Impedance converter, low-pass filter

IC202 (LM324): Quad. op. amp., temperature compensation, linearity

IC203 (AD3): A/D converter of the balance

IC204 (LM329): Reference element of the balance

IC205 (7812T): 12-V voltage regulator

IC206 (7805T): 5-V voltage regulator

IC207 (ICL7662): DC/DC converter
Input: PIN 8/+12 V Output: PIN 5/-12 V

Semiconductors of the A/D converter of the temperature measuring circuit:
IC209, IC210, IC211, IC102, D203, Z201, T203

Z201 (ZPD2, 7): 2.7 V reference voltage for the A/D converter of the
temperature measuring circuit

IC208 (3130): Comparator of the temperature measuring circuit

IC209 (LM358): Dual op amp.,a) constant current source for the temperature measuring sensor, b) integrator of the temperature measuring circuit

IC210 (HCT73): Master slave JK flip flop for linking the timing pulse and the comparator pulse

IC211 (HCT4020): Divides 500 KHz from the processor, output frequency: approx. 60 Hz

T203 (VN1OKN): Switch for charging and decharging the integrator capacitor

OK301 (TLP666JF): Optocoupler element for controlling the triac

TC301 (BT138): Triac for heat control

IC401 (LF444): Quad. op amp., null indicator, temperature compensation

IC402 (CA3193): Regulating amplifier for final stage T402

FD401 (BPX48): Light-receiving diodes of the null indicator

LD401 (LD242II): LED of the null indicator

T401 (BC237B): Temperature sensor

T402 (BC307): Control amplifier for the final stage

T404 (BC237B): Current regulation for LD401

# 3. Testing/Adjusting

## 3.1 Specifications/Adjustment Data

### Specifications

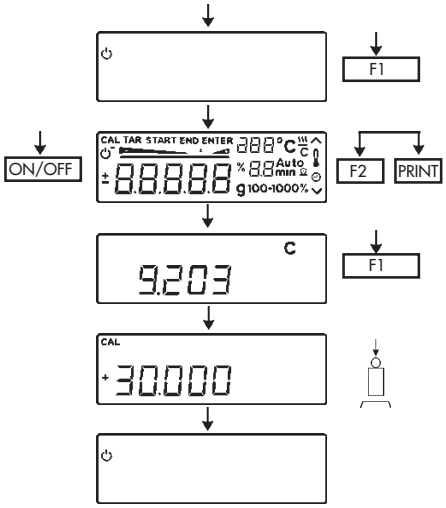
| | |
|---|---|
| Test methods | Heating by infrared rays; determination of weight loss |
| Sample weight | 30 g max., 5- 10 g typical |
| Readability | 0.01% |
| | Measuring accuracy |
| (depending on sample) | 0.05% (at approx. 5 - 10 g) |
| Measuring range (moisture) | 0 - 100% |
| Temperature range | 40 - 160*C |
| Temperature increments | 5*C |
| Ambient temperature range | +10 ..... +40°C |
| Sample dish | 90 mm Ø |
| Housing (W x D x H) | 217 x 283 x 165 mm<br>8.5 x 11.1 x 6.5 in. |
| Net weight | approx. 5.5 kg (12.1 lbs.) |
| Power requirements | 115 V or 230 V (selectable) |
| Frequency | 50 - 60 Hz |
| Allowable voltage fluctuation | -20% +15% |
| Power consumption | 400 VA max. |
| Interface | RS 232 C-S/ V24 - V28;<br>7-bit ASCII; 1,200 baud; odd parity |

### Adjustment Data

| | |
|---|---|
| Preload test weight | Unloaded dish retainer (102), tare weight approx. 15 g |
| Preload voltage | - 650 mV +10 mV |
| Off-center load test weight | 30 g; place weight on the dish retainer within a 22-mm radius for measurement |
| Off-center load tolerance | <= ±1 mg |
| Linearity tolerance | <= ±1 mg |
| Calibration weight (external) | 30 g |
| Temperature control | 40 - 160°C ±5°C<br>with temperature measuring disk 6739-67, thermocouple module 6739-51 and WM |
| Temperature adjustment | 140°C ±3°C using potentiometer P203 |

## 3.2 Calibration

Remove the aluminum sample dish (101) before you calibrate the weighing subassembly of the MA 30; only the dish retainer (102) Ehould be in place.




- Allow the balance to warm up for approx. 30 minutes.
- Switch the MA30 to STANDBY "⏻" with the (**ON/OFF**) key.
- Hold down (**F1**) with your right hand.
- Briefly press the (**ON/OFF**) with your left hand, and,
- during the full-segment display test, press (**F2**) and (**PRINT**) simultaneously. Hold both keys down until a value is displayed without the "g" symbol.
- Release (**F1**) . Values displayed without the "g" symbol are not weights; these values have not been calculated by the processor.
- Press (**F1**) several times. 30.000 is displayed.
- Place the 30-g calibration weight on the cross-shaped dish retainer (102). After a short period, the weight will be stored, and the balance will return to the STANDBY state "⏻". This indicates the end of the calibration procedure.

**Calibration after the Parameter PROM Has Been Exchanged**

If you have exchanged the parameter PROM after performing repairwork on the unit, the MA30 will automatically enter the calibration routine after you press (**ON/OFF**).

- Press (**F1**); 30.000 appears in the display.
- Place the required calibration weight (30 g) on the unit. After a short period, the weight will be stored, and the weighing system will return to the STANDBY mode "⏻". This indicates the end of the calibration procedure.

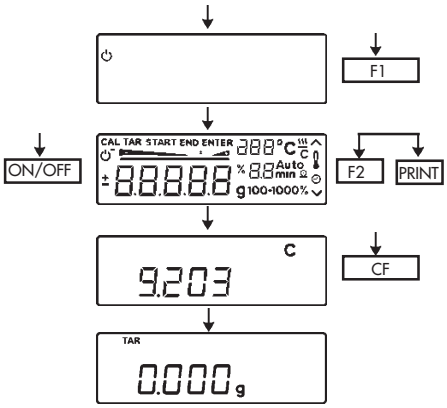
## 3.3 Adjusting the Temperature

- Warming up the MA30 approx. 30 minutes.

- Set the following drying parameters for temperature measurement:

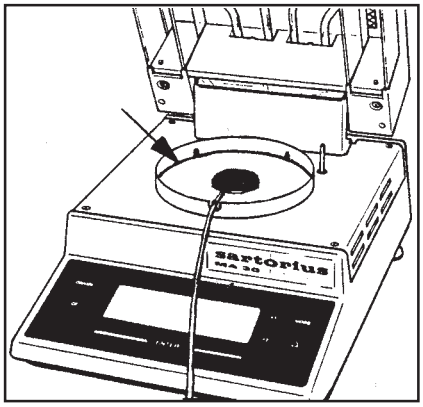
  140°C, 99 minutes of drying time.

The maximum loading capacity of the weighing system is 30 g. However, since the temperature measuring disk is heavier than 30 g, it is necessary to deactivate the overload error message (H) as follows:



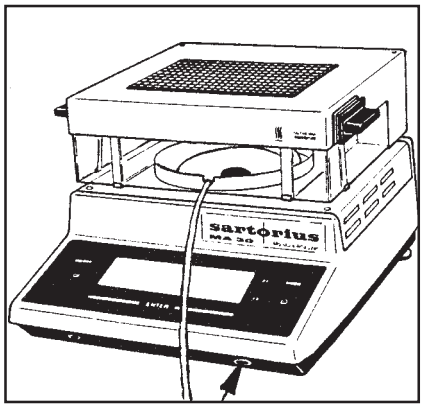

- Switch the MA30 to STANDBY "⏻".
- Hold down (**F1**) with your right hand. Briefly press (**ON/OFF**) with your left hand. During the full-segment display test, press (**F2**) and (**PRINT**), and hold them down until values are displayed without the "g" symbol. These values are uncalculated data.
- Release (**F1**)
- Press (**CF**), Readout: 0.000 g and TAR.

  The H overload error message is now deactivated.



- Tare with (**ENTER**).
  Readout: 0.000 g without TAR
- Place the disk for temperature measurement, number 6739-67, on the cross-shaped dish retainer with the black side facing upward.
- Switch the digital voltmeter (DVM) to a range of 200 mV.
- Connect the temperature measuring disk (6739-67) to the thermocouple module (6739-51), and plug the thermocouple module into the DVM.
- Set the thermocouple module to °C, and turn on the DVM.
- Lower the hood and start the drying routine.
- Wait 20 minutes. During the last five minutes, write down six values at equal intervals.
- Average the measured values to obtain the mean value.

  **Tolerance:** 140°C ±5° C



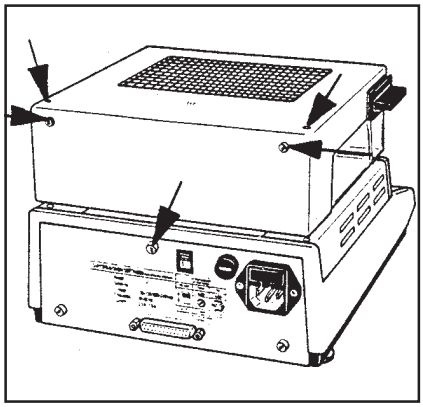
If the average is outside the tolerance limit, adjust the temperature accordingly using the P203 potentionmeter located on the front right of the unit (the potentiometer on the right under the plastic cap).

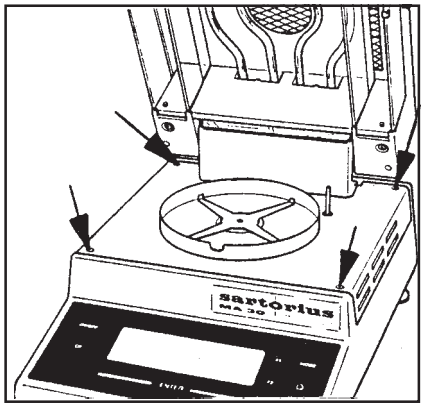
One complete clockwise turn: Temperature is increased by 2-4°

- Wait 15 minutes. During a 5 minute period, write down six values at equal intervals.
- Average the values to obtain the mean value. If the average is within the tolerance limit, check the temperature again when it reaches 50°C ±5°C.

P202, front, right plastic cap, left side exchanges the basic adjustment at 40 - 160°C. An adjustment will be factory set only.

### 3.4 Opening the MA30 Housing





- Disconnect the MA30 from supply power.
- Remove the aluminum sample dish (101), the cross-shaped dish retainer (102) and the protective disk plate (103) from the drying chamber.
- Loosen the two screws on the back of the hood and slide them through the slots toward the inside. Now two holes on the top of the hood are accessible.
- Remove the four screws from the cover plate (105).
  Both front screws are directly accessible when the hood is raised. When the hood is lowered, the two rear screws can be accessed through the rear holes. Remove the yellow plastic plates (106, 107), plastic jacks (115,116) and the small rear retainer plates (108).
- Unscrew the 4 alan screws in the top of the housing (112) and lose the screw on the back side.
- Carefully lift off the housing cover and lay it vertically next to the housing base on the left side.

**Caution: Remove the cover carefully to avoid damaging the cable connections!**

## 3.5 Testing the Weighing Subassembly

The weighing cell of the MA30 is practically identical weighing cell in the MA50 Moisture Analyzer and the H51 Handy Analytical Balance, aside from a few slight changes. Only authorized service technicians, who have been specially trained to repair such units and have the required special equipment for H51, should perform repairwork on the unit.

For information on troubleshooting, adjustments and repairs, please see the **Service Manuals for Handy/Gem Balances or for the MA50 Moisture Analyzer.**

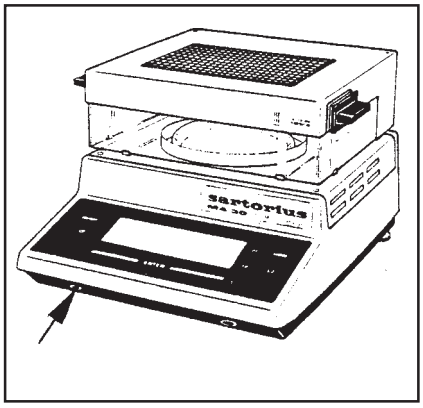
- Place the cross-shaped dish retainer (102) on the sample dish adapter (406).
- Plug in the power cord. Standby "⏻" appears in the display. Turn on the unit.
  MA 30 performs a full-segment display test and displays 0.000 g to indicate that the test has been completed.
- Check the capacity of the unit by placing small weights on the dish retainer.
- If the weights displayed are within the tolerance range, the weighing subassembly functions properly. If the weights are not within the tolerance limit, recalibrate the weighing system as described in section 3.2., "Adjusting."

  If the weights displayed are unstable, or if "L" or "H" appears, there is a defect in the weighing cell or the electronic circuitry of the weighing subassembly.

  Check the weighing subassembly and adjust it. Please see the Service Manual for Handy/Gem Balances or the MA50 Moisture Analyzer (30-g capacity).

  **Preload test weight:** Cross-shaped dish retainer (102) Tare weight: 14.41 g min., 15.8 g max.

  **Proload voltage at the precision resistor:** -650 mV ±10 mV. Increase or decrease the preload weights (420) until the tolerance limit is reached.




You can adjust the **corner load** even when the housing is closed.

- Remove parts 103, 104, 105, 106 and 107.
  The corner load adjustment screws are located under protective caps (104).
  The **linearity potentiometer** is located behind the plastic cap (110).

  To test the electronic circuitry of the weighing system, refer to test points 1 through 12 in section 3.7, "Test Points."

## 3.6 Testing the Drying Subasseably

Before you can begin to test the drying subasseably, the weighing subassembly must function properly. See section 3.5, "Testing the Weighing Subassembly."

- Plug the power cord into the unit. The “⏻" symbol is displayed. Turn on the unit.
  Now the MA 30 performs a full-segment display test and indicates 0.000 g in the display when the segment check is completed.
  If there is an error, the “⏻" symbol will be displayed after the full-segment display test. See section 1.6, "Error Messages" in addition.
- Tare MA30 while pressing (**ENTER**) .
- Place a small weight on the unit and start the drying routine.

  Possible defects: The dryer has started; controls the heat output at maximum level, but does not control the temperature. See section 1.6 "Error Messages" and test points 13 through 21 listed under section 3.7, "Test Points."

## 3.7 Test Points

**Test points 1 - 12: Elecironic Circuitry of the Weighing System**

**Powor supply:**

1 -12 V DC

2 +5 V DC

3 +12 V DC

**Weighing Subasseably:**

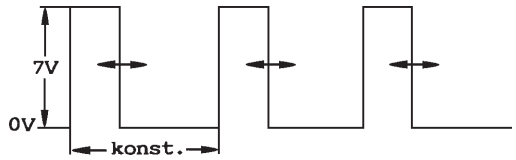
4 Output of null indicator: -2.5 V (wehn the lever is stable)

5 Output of the control amplifier; from approx. 0 V to -DC (depending on the load).

6 Measuring voltage at the precision resistor
0 load:-650 mV
full load:-5 V

7 Analog input to the A/D converter; similar to test point 6 but filtered through the low-pass filter.

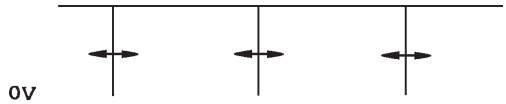
8 Reference voltage: +7 V

9 

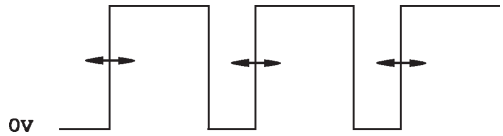

Control signal for the A/D converter

10


Integrator output of the A/D converter

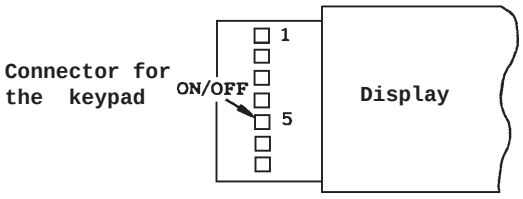
11 


Comparator output

12 


Control signal for the FETswitch
Comparable to test point 9, although inverted and without 7 V

**Test Points 13 - 21: Drying Subassembly**

13 


Reset input TL7705: Test by pressing the ON/OFF key

14 Reset output (can only be measured when the LCD is removed)

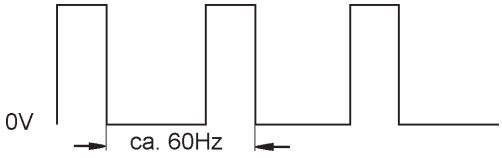
15 Reference voltage for temperature measurement: 2.7 V (ZPD2, 7)

16 DC voltage changes with temperature, i.e., when the temperature sensor is carefully heated with a soldering iron (station equipment).

Voltage at room temperature: approx. 100 mV. Voltage increases when room temperature increases.

17


Discharge time changes with the temperature

18 

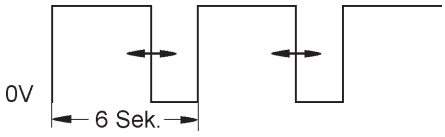

Control signal for the FET switch

19

500 KHz timing pulse from the processor; pulse is divided (approx. 60 Hz) and starts the measuring time (decharges the integrator capacitor).

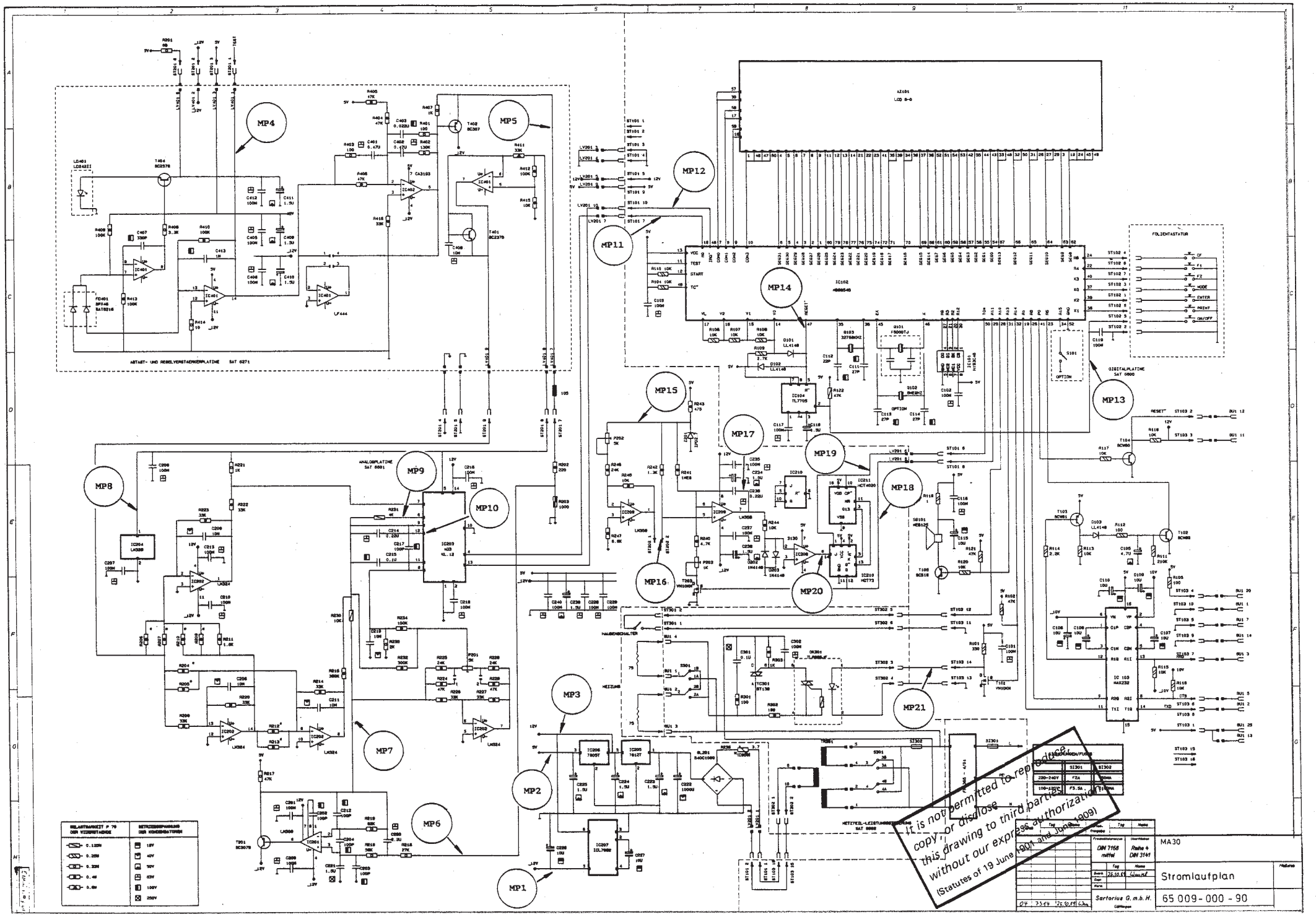
20


Comparator pulse, ends the measuring time and over to charge the integrator capacitor (charging the integrator capacitor)

21 


Control signal to the optocoupler (potential separation). Control cycle lasts approx. 6 seconds. Duty cycle changes with the temperature and depends on the temperature selected.

Supply voltage to the MA30 via a protective isolation transformer when you test the voltage from the optocoupler to the triac.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ANALOGPLATINE SAT 6801
DIGITALPLATINE SAT 6800
FOLIENTASTATUR
HALBSENSCHALTER
HEIZUNG
OPTION
IC102 M68B45
IC103 MAX232
IC104 TL7705
IC201 LC7985
IC202 LM324
IC203 ADJ
IC204 LM385
IC205 7812T
IC206 7805T
IC207 LC7985
IC209 LM358
IC210 HCT373
IC211 HCT4020
LD401 LD242II
T401 BC237B
T402 BC307
T404 BC237B
T901 BC307B
D101 LL4148
D102 LL4148
D103 LL4148
D201 1N4148
D202 1N4148
D203 1N4148
Q101 F8000TJ
Q102 8MEGHZ
Q103 32768KHZ
SB101 HER152
TH201 VH100H
TH202 VH100H
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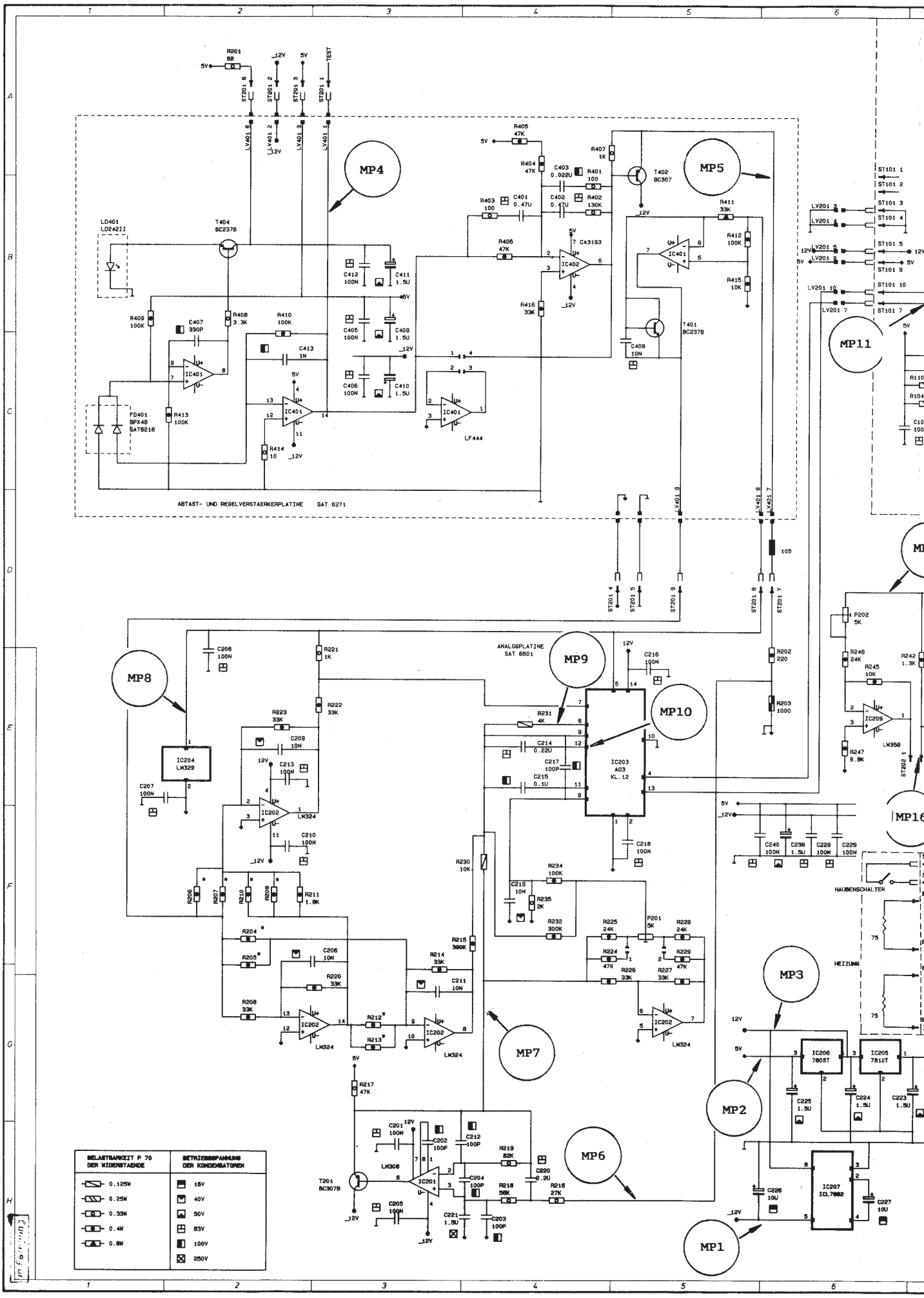
TH220 VH100H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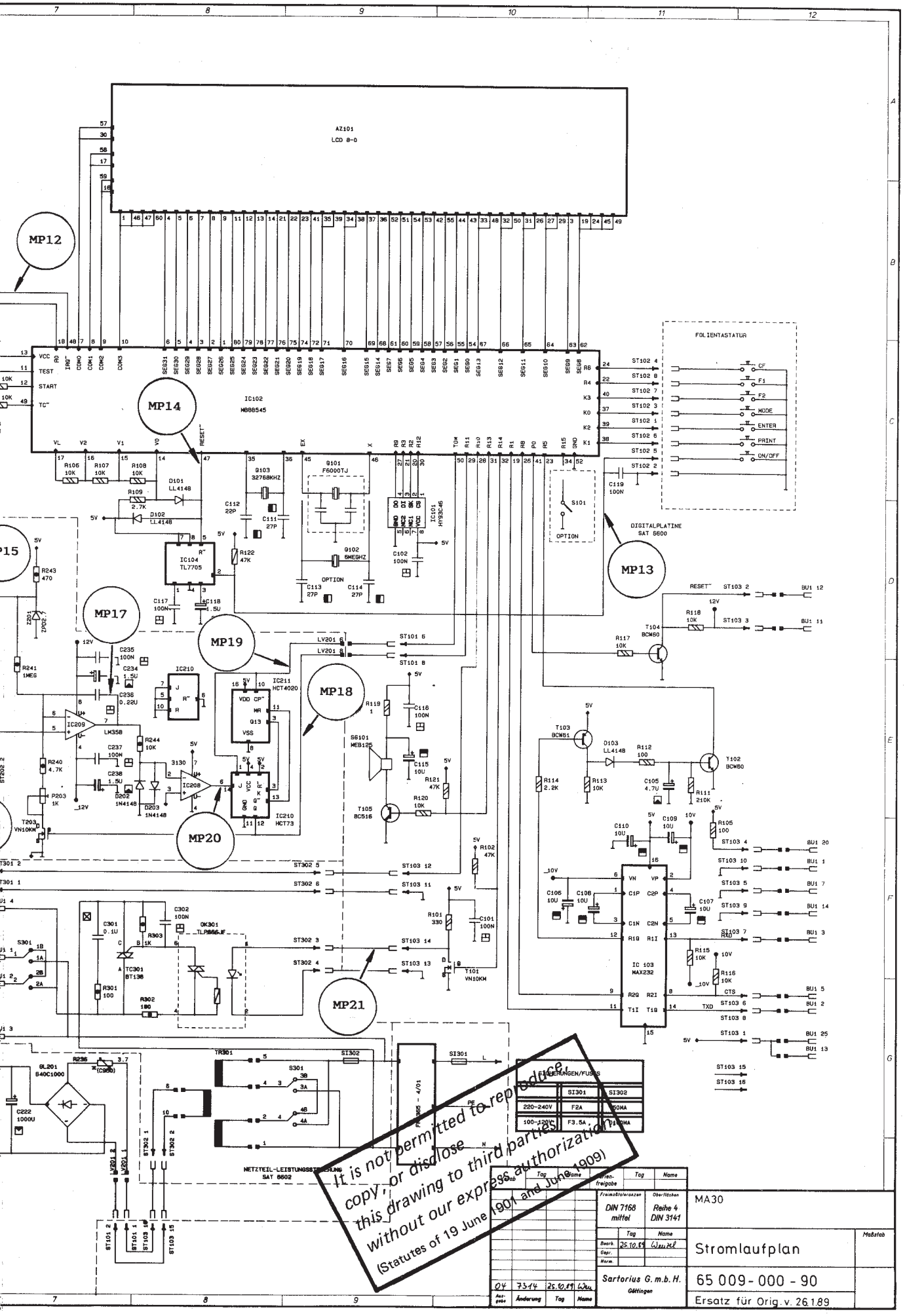
MP11
MP16
LF444
LM324
LM308
HAUBENSCHALTER
HEIZUNG
BELASTBARKEIT P 70 DER WIDERSTAENDE
0.125W
0.25W
0.33W
0.4W
0.6W
BETRIEBSSPANNUNG DER KONDENSATOREN
16V
40V
50V
63V
100V
250V

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